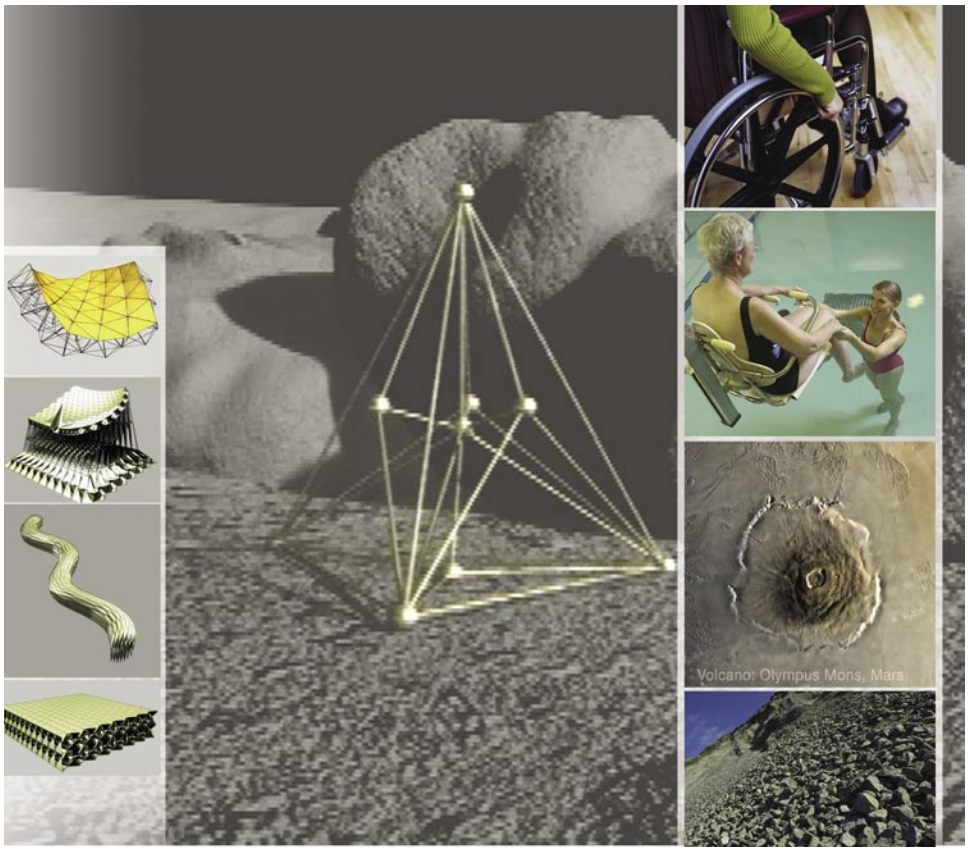
technology Opportunity

National Aeronautics and Space Administration

The Revolutionary TETwalker

... Addressable Reconfigurable Technology (ART) self-adaptable to changing environments and tasks



Benefits

- **Radically reconfigurable and scalable:** Because the shape, size, and volume of its elements can be controlled, the ART structure can take on multiple configurations and perform multiple tasks.
- **Robust:** The tetrahedral shape is the most stable geometric structure.
- **Enhances control:** As the size of each element gets smaller and the number of elements increases, the degree of freedom and level of control is greatly enhanced.
- **Reduces mass:** Having no hard body, the tetrahedron is lightweight and can be very compact but with the ability to expand as needed.
- **Reduces power requirements:** Its low mass has minimal power requirements. Future plans to incorporate nanotechnology will further decrease the required operational power density.
- **Undifferentiated architecture eliminates need for dedicated components:** The technology has the potential to reconfigure itself in response to its changing needs and environments, reducing the need for dedicated tools and components.
- **Reduces failures:** ART intrinsically is massively redundant; if one section is damaged it has the potential—in an advanced form—for self repair.

NASA Goddard Space Flight Center offers the opportunity to partner in the further development of this innovative technology for use in robotics and other applications requiring extreme mobility and adaptability in varied environments.

The TETwalker represents a revolutionary idea in robotics and structural architecture. It is a creative application of Addressable Reconfigurable Technology (ART), developed by NASA researchers at Goddard Space Flight Center working jointly with Langley Research Center. This highly integrated three-dimensional mesh of actuators and structural elements has the potential to autonomously change form to optimize its function, reconfigure into specific tools, and perform tasks in a wide range of terrain and environment. This is the first element in the development of a synthetic skeletal muscular and skin system, to be controlled by a synthetic neural system.

Applications

- **Wheel chairs and other assistive devices:** The effective ART skeletal/muscular frame system enables fluid motion over any terrain and supports performance of varied functions.
- **Human performance enhancement and enablement:** ART can function as an adaptive exoskeleton to enhance strength, reach, and other functions.
- **Robots:** The ART's maneuverability and ability to reconfigure itself make it particularly useful in (but not limited to) situations where tasks must be performed in inhospitable environments (e.g., gathering environmental samples, finding and defusing bombs, search and recovery, etc.).
- **Mining:** The ART can be configured for thin-vein mining applications.
- **Toys and novelties:** The unique abilities of the technology also open the door to a new era of toys and novelty items.

The Technology

The tetrahedron module is configured using readily available, addressable, electro-mechanical components. Lightweight telescoping struts are attached at each end to pivoting nodes to allow movement over a wide range of angles. Motors within the nodes control the telescoping struts, allowing specific sections of the tetrahedron to lengthen or shorten, changing its center of mass. This enables the tetrahedron to maneuver in a controlled flip-flop motion by toppling over in alternating directions.

By grouping multiple tetrahedra, many degrees of freedom/function and much smoother locomotion are possible, including the formation of flattened and conformable surfaces (e.g., draping over obstacles) as well as slithering, rolling, and amoeboid/caterpillar-like motions. Independent shaping of the top and bottom interconnected nodes is also possible, to allow reconfiguration for multiple complex functions, such as forming tools and for communications.

While the TETwalker is currently controlled remotely, also under development is a synthetic neural system to enable the TETwalker to function autonomously. This neural system will allow the TETwalker to adapt and actively reconfigure itself according to its environment and recognized needs. Like the physical architecture, the neural system has a three dimensional node-driven architecture.

Future developments will reduce size using Micro-Electro-Mechanical Systems (MEMS) and then further using Nano-Electro-Mechanical Systems (NEMS). With this refinement, even greater control and agility will be possible.

Partnering Opportunities

This technology is part of NASA's technology transfer program. ART allows for ready infusion of new technologies. NASA invites companies to consider partnering in the further development of ART.

For More Information

If you are interested in more information, or want to pursue partnership for further development of this technology, please contact:

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